North Coast Watershed Assessment Program

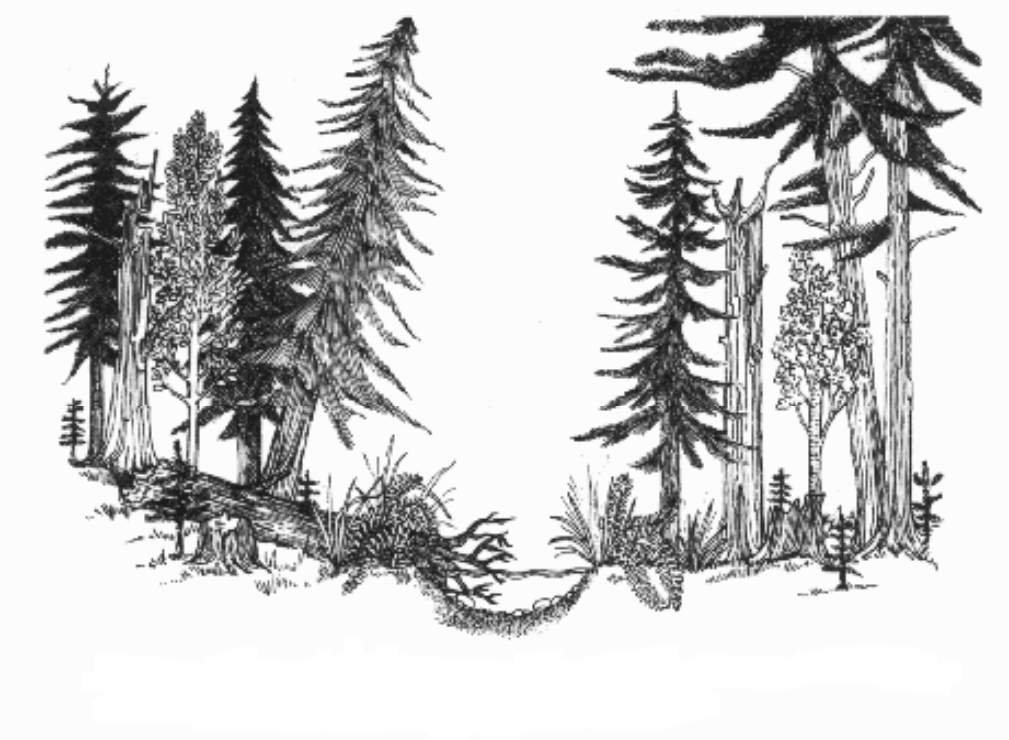
DRAFT

Mattole Watershed Synthesis Report

The mission of the North Coast Watershed Assessment Program is to conserve and improve California's north coast anadromous salmonid populations by conducting, in cooperation with public and private landowners, systematic multi-scale assessments of watershed conditions to determine factors affecting salmonid production and recommend measures for watershed improvements.

Public Review Draft - March 22, 2002

Northern Mattole Subbasin



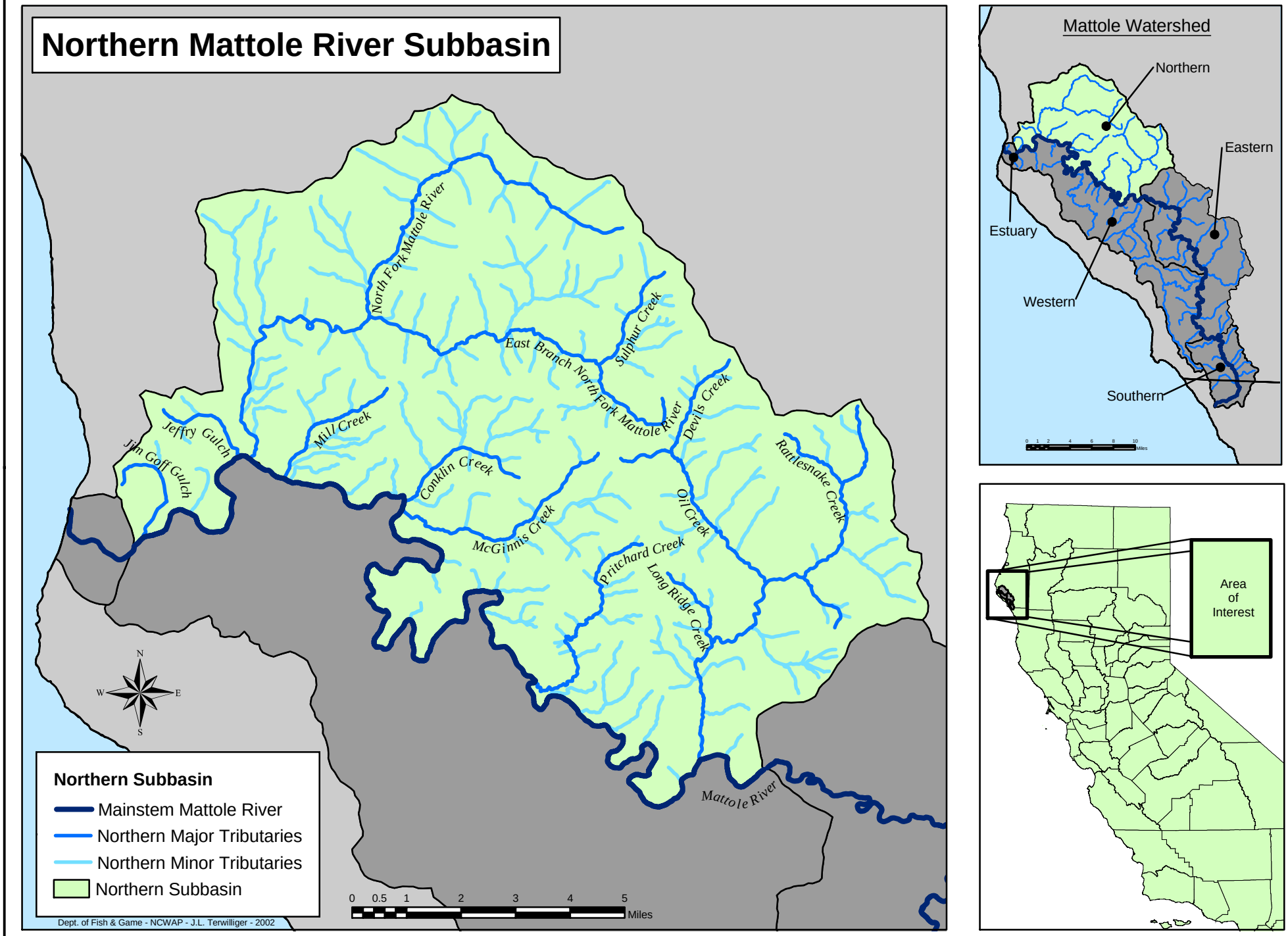
Introduction

The Northern subbasin is located between the Estuary and Honeydew Creek (River Mile 26.5) along the northeastern side of the Mattole mainstem (see map on following page). There are eighteen perennial streams that drain a watershed area of 98 square miles. The DFG recently surveyed 10.6 miles of the subbasin's anadromous reaches. Elevations range from 5 feet at the estuary to approximately 2,500 feet in the headwaters of the tributaries.

The watershed is largely managed for timber production and cattle ranching. The town of Petrolia is located in this subbasin at the confluence of the Lower North Fork and the Mattole River. Some back-to-land homesteads are near Petrolia. Controversy concerning timber harvest issues between the Pacific Lumber Company and the "Defenders of the Mattole" are focused on Rainbow and Long ridges in this subbasin. Although Pacific Lumber is operating under an approved Habitat Conservation Plan, some of their timber harvesting plans are first entries into old-growth stands, causing protests that include civil disobedience.

Climate

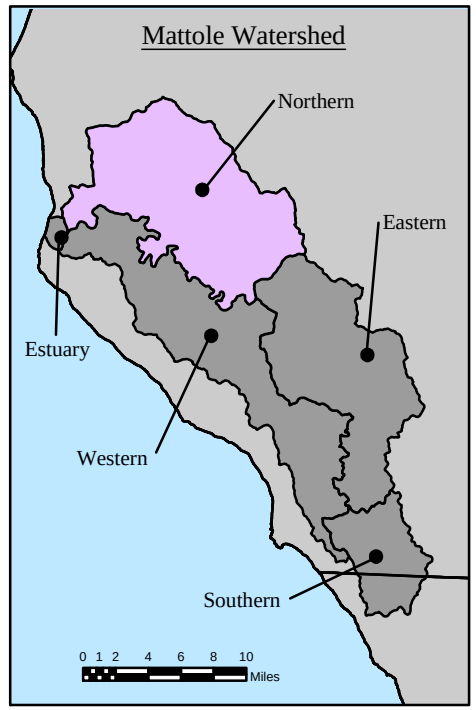
The Northern subbasin experiences the widest range of both temperature and precipitation. Air temperatures range from below freezing in winter to over 100° F in summer. Temperatures near Petrolia are moderated year-round by the proximity of the ocean while the inland areas experience the extremes. Rainfall averages range from 60 inches near Petrolia to 115 inches on the eastern ridgetops. Although most precipitation falls as rain, snow falls in the higher regions of the subbasin are not uncommon.

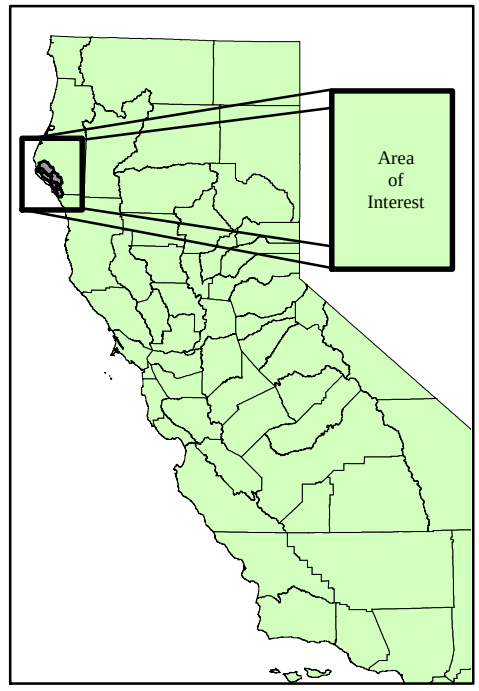

Northern Mattole River Subbasin
North Fork Mattole River
East Branch North Fork Mattole River
Sulphur Creek
Devils Creek
Rattlesnake Creek
Oil Creek
Pritchard Creek
Long Ridge Creek
McGinnis Creek
Conklin Creek
Mill Creek
Jeffry Gulch
Jim Goff Gulch
Mattole River
N
W
E
S
Northern Subbasin
Mainstem Mattole River
Northern Major Tributaries
Northern Minor Tributaries
Northern Subbasin
0 0.5 1 2 3 4 5
Miles
Dept. of Fish & Game - NCWAP - J.L. Terwilliger - 2002

Mattole Watershed
Northern
Eastern
Estuary
Western
Southern
0 1 2 4 6 8 10
Miles

Area
of
Interest

Northern Mattole Planning Watersheds





Hydrology

The Northern Subbasin is made up of nine complete Calwater Units and includes most of the Petrolia Calwater Unit (see map previous page). There are 69.6 perennial stream miles in 18 perennial tributaries in this subbasin Table 16). Seven of these tributaries have been inventoried by DFG. There were 11 reaches, totaling 10.6 miles in the inventory surveys. The inventories included channel and habitat typing, and biological sampling.

Table 16: Surveyed Streams with Estimated Anadromy in the Northern Subbasin.

Stream	DFG Survey (Y/N)	DFG Survey Length (miles)	Estimated Anadromous Habitat Length (miles)	Reach	Channel Type
Jim Goff Gulch	N		0.7		
Jeffry Gulch	N				
Lower North Fork Mattole River	N		8.0		
East Branch Lower North Fork Mattole River	N		0.9		
Sulphur Creek	Y	0.5		1	B4
Unnamed Tributary #1 to Sulphur Creek	Y	0.1		1	C4
Unnamed Tributary #2 to Sulphur Creek	Y	0.5		1	B4
Conklin Creek	Y	0.6	2.2	1	C4
McGinnis Creek	N		3.1		
Thornton Creek	N				
Pritchett Creek	N				
Singley Creek	N				
Holman Creek	N				
Upper North Fork Mattole River	N		3.5		
Oil Creek	Y		3.3		
	Y	0.3		1	A4
	Y	2.0		2	B2
	Y	0.3		3	A4
	Y	0.7		4	A2
Green Ridge Creek	Y	0.7	0.6	1	A2
Devil's Creek	Y		0.8		
	Y	0.7		1	B2
	Y	0.7		2	A3
Rattlesnake Creek	Y	4.2	3.0	1	

In their inventory surveys, DFG crews utilize a channel classification system developed by David Rosgen (1994) and described in the *California Salmonid Stream Habitat Restoration Manual* (Flosi, et al., 1998). Rosgen channel typing describes relatively long stream reaches using eight channel features: channel width, depth, velocity, discharge, channel slope, roughness of channel materials, sediment load and sediment size. There are eight general channel types in the Rosgen classification system.

In the Northern Subbasin, there were five type A channels, totaling 2.7 miles; four type B channels, totaling 3.7 miles; and two type C channels, totaling 0.7 miles. Type A stream reaches are narrow, moderately deep, single thread channels. They are entrenched, high gradient reaches with step/pool sequences. Type A reaches flow through steep V- shaped valleys, do not have well-developed floodplains, and have few meanders. Type B stream reaches are wide, shallow, single thread channels. They are moderately entrenched, moderate to steep gradient reaches, which are riffle-dominated with step/pool sequences. Type B reaches flow through broader valleys than type A reaches, do not have

well-developed floodplains, and have few meanders. Type C stream reaches are wide, shallow, single thread channels. They are moderately entrenched, low gradient reaches with riffle/pool sequences. Type C reaches have well-developed floodplains, meanders, and point bars (Flosi, et al., 1998).

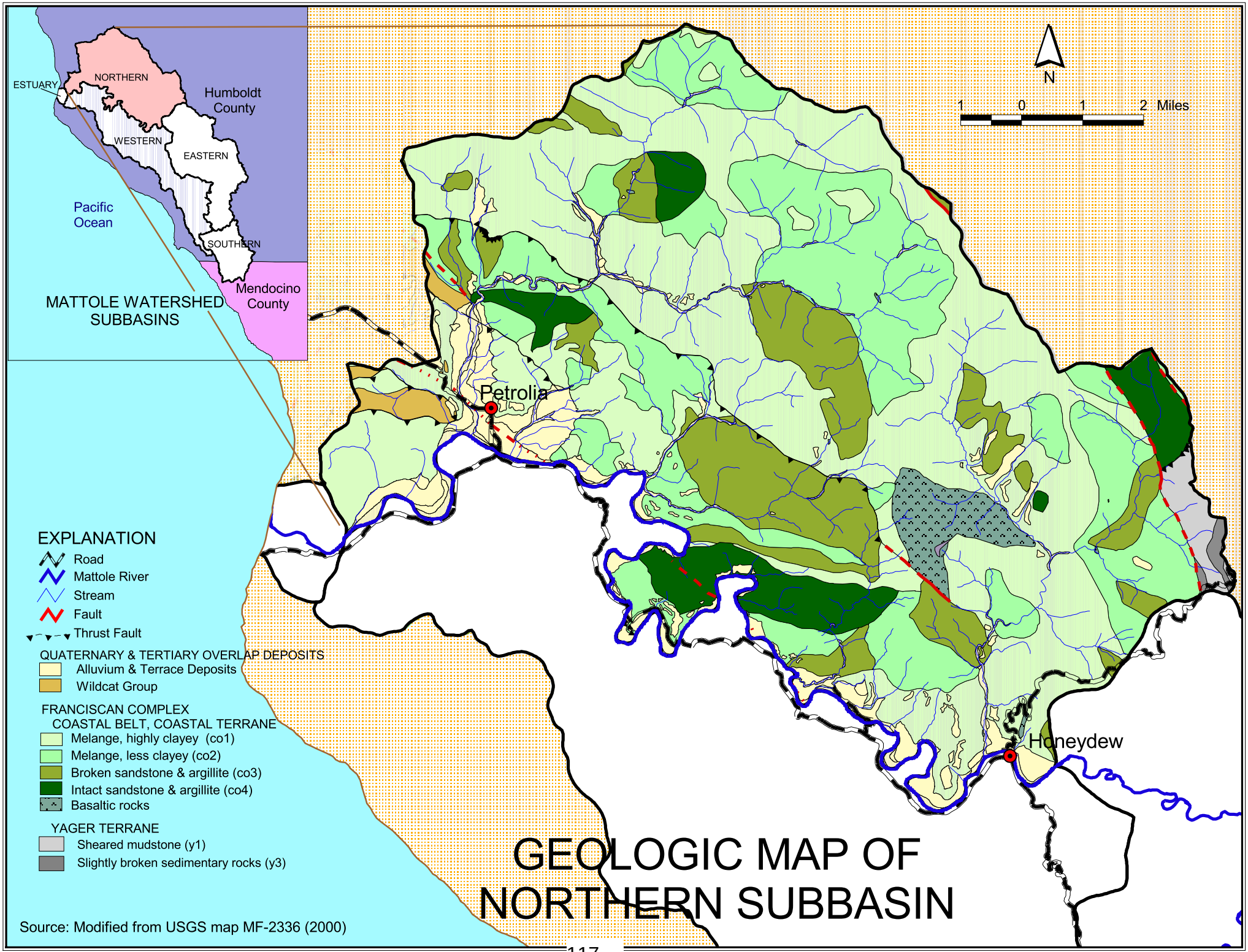
Geology

The geology of the Northern subbasin is overall the most structurally disrupted and most susceptible to landslides and erosion of the basin. The bedrock underlying the northern subbasin is dominated by mélange and broken units of the Franciscan Coastal terrane composed of scattered blocks of intact rock set within a matrix of pervasively sheared argillite and sandstone. The mélange is generally too weak to support development of steep slopes. Accordingly, a soft topography of rolling hillsides, moderate slopes and rounded crests has developed over much of that portion of the mélange, which consists of pervasively sheared argillite, particularly in the northerly portion of the watershed. This unit was mapped as co1 by McLaughlin (1990). Relatively deep weathering profiles and clayey residual soils tend to develop subject to chronic down-slope movement through soil creep. Grassy vegetation generally develops in these areas of weathered mélange, as conifer and hardwood trees have a difficult time becoming established on the mobile mantle of clayey soil. That portion of the mélange consisting of pervasively sheared sandstone and argillite forms a moderate topography. The limited portion of the subbasin underlain by broken and intact sandstone and argillite units of the Franciscan Coastal terrane form a hard terrain. The terrain distribution for the entire Mattole Watershed is presented on maps within the *Mattole Watershed Profile – Geology* section of this report.

An abundance of active and dormant landslides of different types have been mapped in the subbasin, including large landslide complexes that impact entire hillsides covering many 100's of acres. Historically active earthflows are particularly common here in comparison to their occurrence in the other subbasins. These landslide are particularly concentrated in the soft terrain of the argillite mélange, and to a lesser degree in the moderate terrain. Debris slide slopes occur primarily in the limited area of hard terrain but locally there are largely scattered continuous areas of these features in the moderate terrain. The delivery of sediment to streams through gully erosion and debris slides associated with large active and dormant landslides is also prevalent in the subbasin. Debris flows and debris slides, as well as debris slide slopes all form on the harder terrain at higher elevations. The landslide occurrence on the three terrains is presented on maps within the *Mattole Watershed Profile – Geology* section of this report.

In the Lower North Fork Mattole River, the high rate of sediment input from erosion and mass wasting is reflected in the accumulation of debris and alluvial fans at the mouths of many tributary drainages. An irregular drainage pattern lacking a preferred orientation and spacing has developed on the disrupted bedrock geology underlying the upper reaches of most streams in the Northern subbasin. Terrace remnants of older alluvial deposits and strath surfaces extend over the broad valley bottoms above the active channel.

Based on presence of weak argillite mélange and associated high concentration of large landslides, most of the soft terrain has been interpreted as having very high landslide potential. The moderate terrain has been mapped mostly as a moderate to high landslide potential with the areas underlain by large active landslides being in the very high category. The hard terrain has been mapped mostly in the moderate landslide potential with areas of high to very high potential where underlain by active or dormant landslides or debris slide slopes.


ESTUARY
NORTHERN
WESTERN
EASTERN
SOUTHERN
Humboldt County
Pacific Ocean
Mendocino County
MATTOLE WATERSHED SUBBASINS
N
1 0 1 2 Miles
Petrolia
Honeydew
EXPLANATION
Road
Mattole River
Stream
Fault
Thrust Fault
QUATERNARY & TERTIARY OVERLAP DEPOSITS
Alluvium & Terrace Deposits
Wildcat Group
FRANCISCAN COMPLEX
COASTAL BELT, COASTAL TERRANE
Melange, highly clayey (co1)
Melange, less clayey (co2)
Broken sandstone & argillite (co3)
Intact sandstone & argillite (co4)
Basaltic rocks
YAGER TERRANE
Sheared mudstone (y1)
Slightly broken sedimentary rocks (y3)
GEOLOGIC MAP OF NORTHERN SUBBASIN
Source: Modified from USGS map MF-2336 (2000)

Vegetation

Unless otherwise noted, the vegetation description in this section is based on manipulation of Calveg 2000 data. This is vegetation data interpreted from satellite imagery by the United States Forest Service, Remote Sensing Lab. The minimum mapping size is 2.5 acres.

Occupying 31% of the northern subbasin, there is more grassland in this subbasin than in any of the others (Figure 19). Mixed hardwood and conifer forests cover 44% of the area, conifer forest 11%, and hardwood forest 12% for a total of 67% forested area. The forested vegetation reflects the impacts of harvesting and wildfire. Two fires in 1990 covered 6,700 acres, mostly in the Oil Creek and Camp Mattole planning watersheds. 40% of the Northern subbasin is in the 12 to 23.9 inch diameter breast height (dbh) size class. Some stands of old-growth Douglas-fir forest are in private ownership. Shrub, barren, agricultural lands, and urban classifications together cover the remaining 2% of the area.

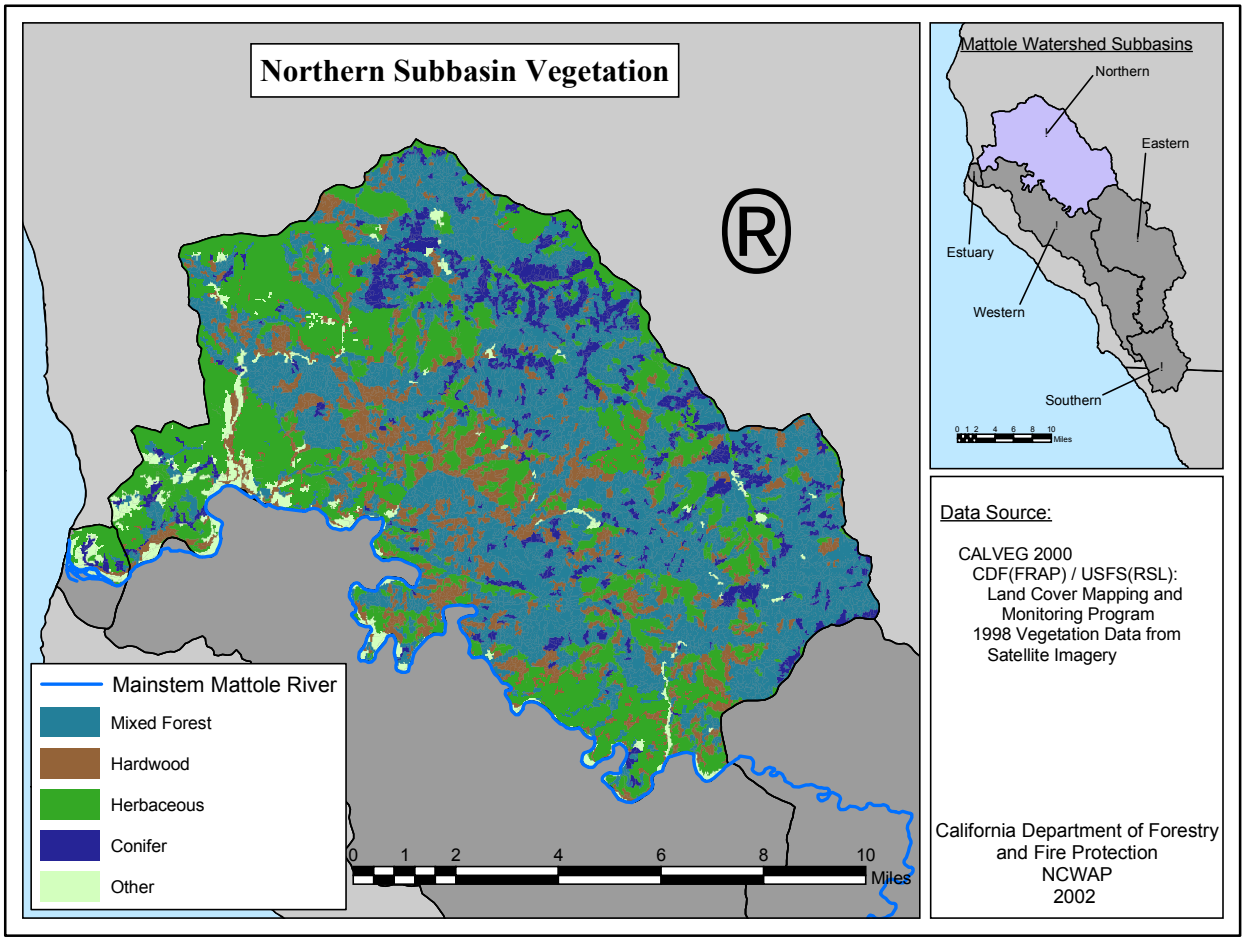


Figure 19: Vegetation Pattern of the Northern Subbasin.

Land Use

Census 2000 data indicates that 200 people have their permanent residence in this subbasin, many of them in and surrounding the town of Petrolia. Grazing and timber management are the major land use activities (Figure 21, Table 17). Grazing activity is primarily on non-irrigated natural grasslands. The 1941 aerial photographs show widespread indications of grazing and written accounts make it clear that Petrolia and the surrounding grasslands have influenced the local landscape since settlement in the 1860s. This subbasin contains the largest blocks of ownership in private hands, including Pacific Lumber (~18,000 acres) as the major industrial timberland owner (Figure 20). Timber harvesting since 1983 has occurred on a small percentage of the subbasin, almost entirely on industrial timberland.

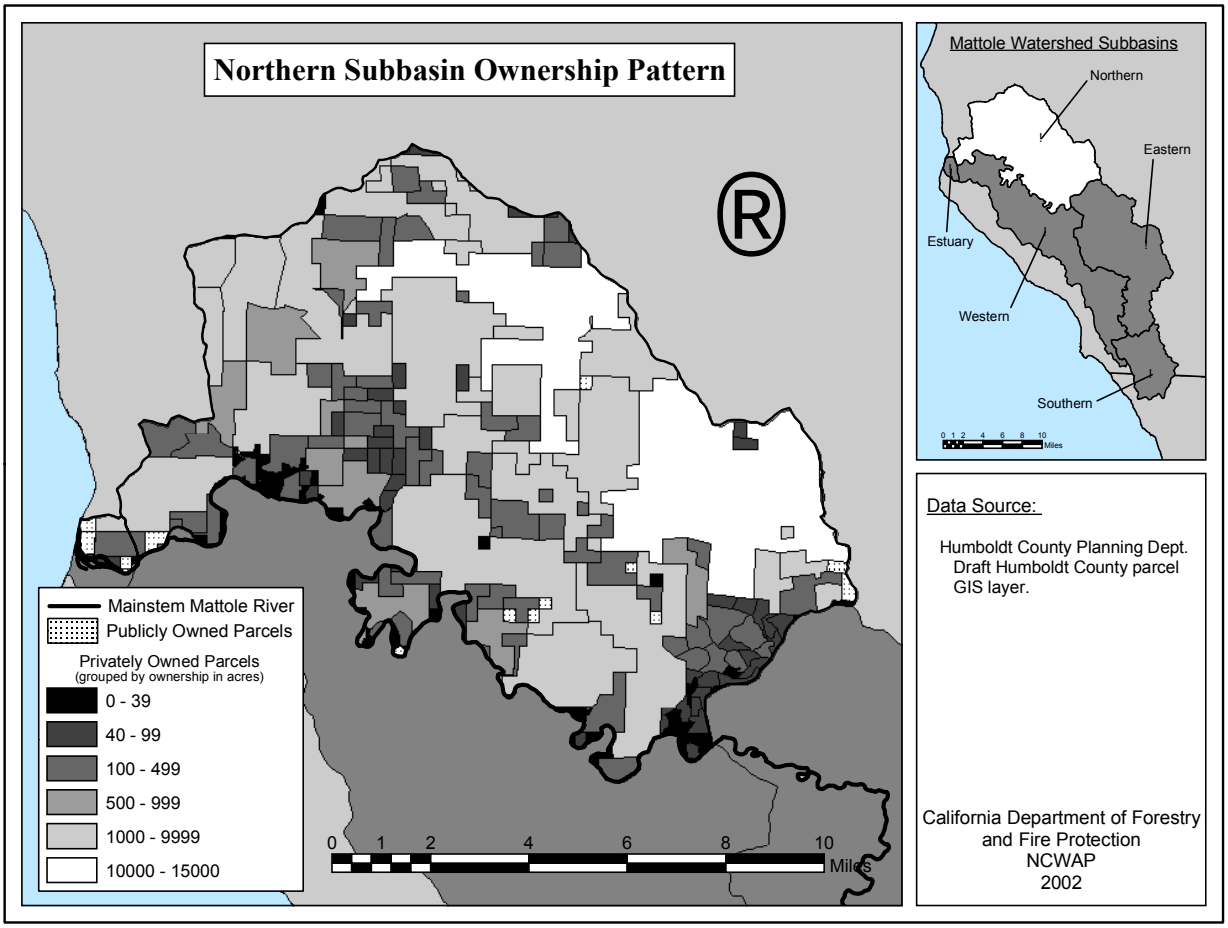


Figure 20: Ownership Pattern of the Northern Subbasin.

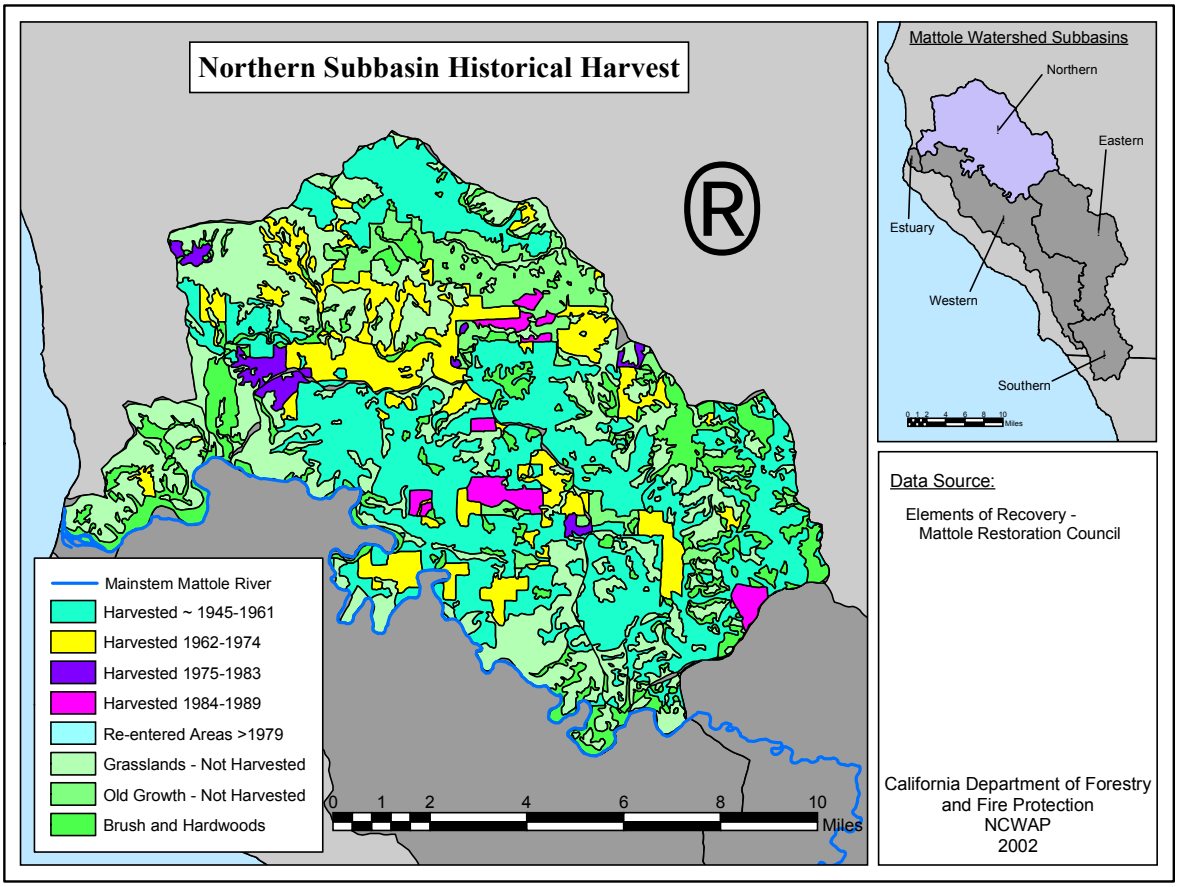


Figure 21: Timber Harvest History for the Northern Subbasin.

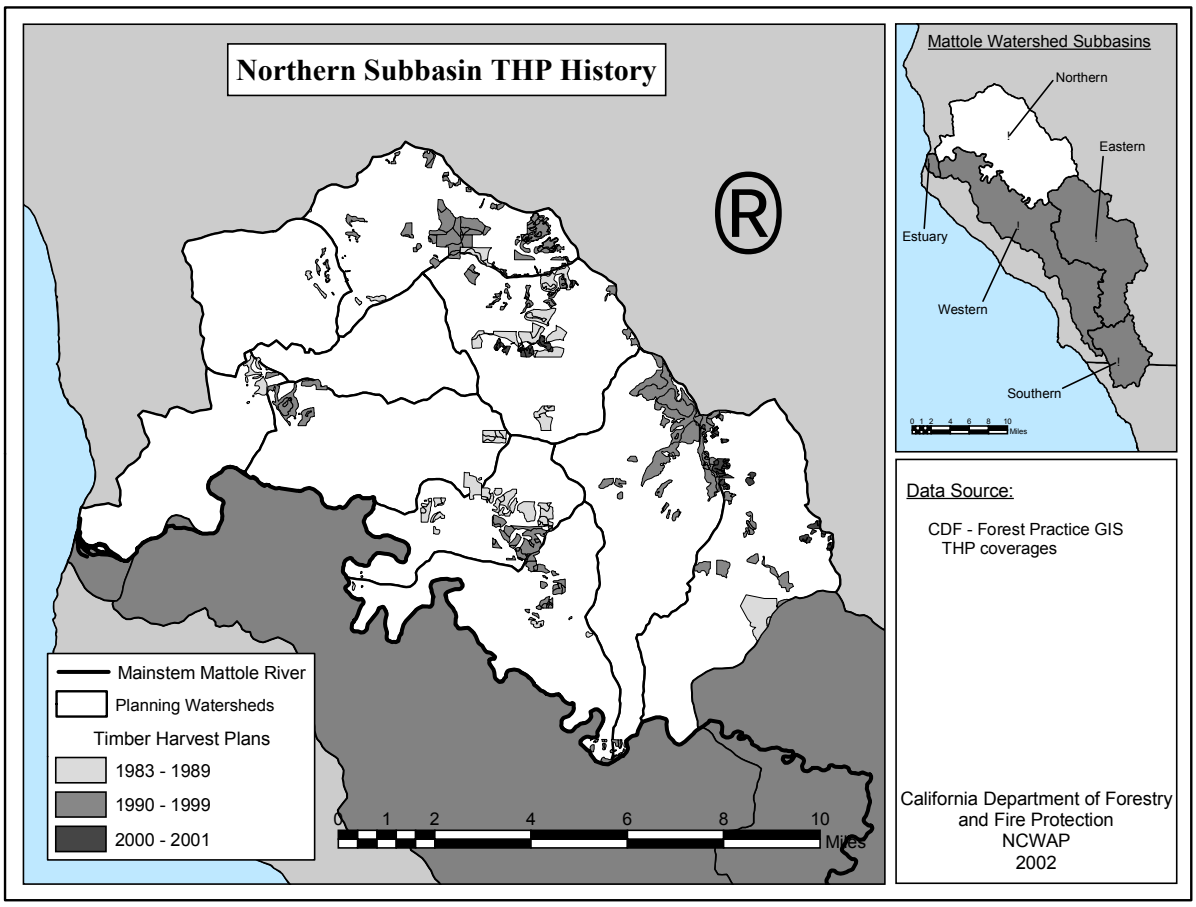


Figure 22: Timber Harvesting Plan History 1983-2001, Northern Subbasin.

Timber harvesting covered a substantial portion of the basin prior to the 1964 flood. Aerial photograph interpretation of 1941 and 1952 flights show the main activity appears to be maintenance of grassland and conversion of forestland to grassland. In many cases, this was by use of fire and often standing dead trees were present while there was no indication of skid trails for harvesting. Later, as timber harvesting occurred, the logging method was tractor logging down to streamside road systems. The silviculture was a type of seed tree cut that often left brush and some conifer. The resulting effects are still present. Timber harvesting activity since 1983 has covered about 10% of the subbasin. One area of locally intensive harvest, in the Oil Creek planning watershed, was a sanitation/salvage harvest following the 1990 Rainbow wildfire. Since 1983, there is still a large percentage of tractor logging by area. The silvicultural systems appear to be based on the uneven nature of the stands that were left after the first entries and primarily consist of even-aged regeneration methods. About one-fifth of the acres have had a commercial thin or selection treatment.

Table 17: Timber Harvest History, Northern Mattole Subbasin.

TIMBER HARVEST HISTORY - NORTHERN MATTOLE SUBBASIN		
	Total Acres	Percent of Area
Harvested 1945-1961	21,555	34%
Harvested 1962-1974	7,675	12
Harvested 1975-1983	968	2
Harvested 1984-1989	1,628	3
Harvested 1990-1999	3,440	5
Harvested 2000-2001 (partial)	339	<1

Fluvial Geomorphology

The Northern subbasin is characterized by the highest percentages of mapped channel characteristics, gullies, and lateral bar development. The planning watersheds (PWs) that make up the Northern subbasin include: Apple Tree, Camp Mattole, Cow Pasture Opening, Joel Flat, Long Ridge, McGinnis Creek, Oil Creek, Petrolia, Rainbow, and Rattlesnake Creek.

Table 18 documents the number of sites and summarizes the lengths of eroding bank features within the Northern subbasin. In general, stream bank erosion has been observed within all of the planning watersheds within this subbasin. The number of eroding bank sites range from one in the Joel Flat PW to 12 in the Rattlesnake Creek PW. The Rattlesnake Creek PW has been mapped with a total length of approximately 2500 meters of eroding bank; about 10 percent of the stream length within the PW.

Table 18: Eroding Stream Bank Lengths - Northern Subbasin Planning Watersheds.

Northern Subbasin Planning Watersheds	*2000 Photos*			
	Number of Sites w/in PW	Maximum Length (m) of Eroding Bank w/in PW	Total Length (m) of Eroding Bank w/in PW	Approx. % Eroding Bank to Stream Length w/in PW
Apple Tree	5	190	544	4
Camp Mattole	5	205	588	3
Cow Pasture Opening	2	140	228	<1
Joel Flat	1	135	135	1
Long Ridge	8	380	1493	7
McGinnis Creek	7	495	1088	5
Oil Creek	9	220	998	3
Petrolia	2	165	314	2
Rainbow	5	175	652	2
Rattlesnake Creek	12	890	2496	9

Table 19 illustrates the range in mapped channel characteristics, gullies, and lateral bar development from 1984 and 2000 aerial photographs. In general, mapped channel characteristics range from 80 to less than 10 percent of the overall channel length; gullies range from 25 to less than 5 percent of the overall containing area; and lateral bar development ranges from low to high values within subreach lengths.

Table 19: Fluvial Geomorphic Features - Northern Mattole Subbasin.

	2000 Photos			1984 Photos		
Planning Watersheds	% Disturbed Channel [1]	% Gullies [2]	Lateral Bar Development [3]	% Disturbed Channel [1]	% Gullies [2]	Lateral Bar Development [3]
Apple Tree	<10-25	15-25	2-3	25-50	5	3-4
Camp Mattole	<50-60	10-25	3-5	<50-60	10-20	3-4
Cow Pasture Opening	<20-40	5-15	1-2	10-25	2	2-3
Joel Flat	<5-15	15-25	1-3	<10-35	2-5	2-3
Long Ridge	60-80	10-20	4-5	50-80	10-15	4-5
McGinnis Creek	<50-75	5-10	4-5	<50-80	<5	3-5
Oil Creek	<50-80	15-25	4-5	50-80	10-20	4-5
Petrolia	<10-40	15-25	3-5	<10-50	<5-10	4-5
Rainbow	50-80	10-15	4-5	<50-80	5	4-5
Rattlesnake Creek	<40-70	<5-15	3-5	50-80	<5-10	4-5

All values are visual approximations at this stage and subject to change as GIS data becomes available.

[1] Features include: lack of riparian vegetation, distribution and number of lateral or mid-channel bars, multi-thread channels, cut-off chutes, channel bank erosion, and shallow landslides adjacent to or blocking channels.

[2] Gullies include those that appear active, have little to no vegetation within the incised area, and are of sufficient size to be identified on aerial photos.

[3] Lateral bars include mappable lateral, mid-channel bars and reflect sediment supply and storage. Rankings range from 1-5. Higher values suggest excess sediment

A closer examination of Table 19 reveals that four PWs (Apple Tree, Joel Flat, Petrolia, and Rattlesnake Creek) have shown significant reduction in the length of mapped channel characteristics. Four PWs (Camp Mattole, Long Ridge, McGinnis Creek, and Oil Creek) have remained relatively constant for all categories between 1984 and 2000. In contrast, one PW, Cow Pasture Opening, has shown a significant increase in mappable channel sediment characteristics. In addition, the percentage of gullies has increased in five PWs (Apple Tree, Cow Pasture Opening, Joel Flat, Petrolia, and Rainbow) between 1984 and 2000.

In summary, nine of the ten PWs within the Northern subbasin have remained relatively constant, or exhibited a significant reduction, with respect to mapped channel characteristics and lateral bar development between 1984 and 2000. Half of the subbasins have exhibited an increase in the number

of gullies during this same period. However, only the Cow Pasture Opening PW has demonstrated both an increase in mapped channel characteristics and the number of gullies. The Northern subbasin is the only subbasin within the Mattole Watershed that shows a significant increase in the number of gullies between 1984 and 2000. In addition, several large areas of on-going high sediment deposition were observed along the Lower North Fork near Petrolia and Upper North Fork near Honeydew. These areas of deposition have been attributed to backwater effects with the mainstem Mattole River.

Aquatic/Riparian Conditions

Unless otherwise noted, the vegetation description in this section is based on manipulation of Calveg 2000 data. This is vegetation data interpreted from satellite imagery by the United States Forest Service, Remote Sensing Lab. The minimum mapping size is 2.5 acres.

Vegetation within 150 feet of the centerline of streams is 53% mixed conifer and hardwood forest, 17% hardwood, 10% conifer forest, 10% annual grassland and 7% barren while shrubs, water, agricultural and urban combined make up the remaining 3%. Riparian hardwood plant communities occupy only 2% of this near-stream area while hardwood-dominated timber sites in this zone occupy 1.5% of the area. The large percentage of barren occurs primarily along the Mattole River and the lower reaches of the Lower and Upper North Forks of the Mattole River. The area occupied by this single-width zone is 12% of the total Northern Subbasin acreage.

Visual observation along the County Roads adjacent to the Mattole River and the downstream reaches of the North Fork and the Lower North Fork indicates that the riparian area is often restricted and defined by the location of these roads. The grassland component is mainly adjacent to upslope grassland. In aerial photos it can be seen that while there are a tremendous number of springs originating near the ridgetops, some of which have definite channels and narrow riparian strips connecting to the stream systems, many tributaries in the grassland lack riparian vegetation. Hardwood-dominated timber site is a classification that categorizes the area as a commercial timber site that has been converted to a vegetation type that no longer contains conifers.

Fish Habitat Relationship

The subbasin supports populations of chinook salmon and steelhead. In fact, the upper tributary reaches of the Upper North fork has relatively dense, multi-year class juvenile steelhead rearing populations based upon the DFG monitoring efforts from 1992-1995. This occurs in spite of very warm summer water temperatures due, it seems, to a plenitude of cold springs, seeps, and small tributaries that provide thermal refugia. Coho were once here, but have not been found recently.

Fish History and Status

Historically, the Northern Subbasin supported runs of chinook salmon, coho salmon, and steelhead trout. Interviews with local residents indicate that chinook salmon and coho salmon were found in the Lower North Fork Mattole River, East Mill Creek, and Conklin Creek, and possibly in Jim Goff Gulch and McGinnis Creek (Coastal Headwaters Association 1982). The DFG stream surveys in the 1960s found steelhead trout in eleven streams, unidentified salmonids in Pritchett Creek, and coho salmon in East Mill Creek and Devil's Creek. High densities of steelhead trout were estimated for the East Branch of the Lower North Fork Mattole River (500 per 100 feet of stream) and East Mill Creek (300 per 100 feet of stream) in June 1966.

A study of the standing stock of Mattole Basin salmonids conducted in July and August 1972 (Brown, 1973b) examined two sites on the Lower North Fork of the Mattole River, 0.5 miles downstream of the Petrolia Road Bridge and 1.5 miles above the mouth. Steelhead trout were found at densities of 122 and 250 per 100 feet of stream, respectively.

BLM, Coastal Headwaters Association, and DFG stream surveys have continued to document the presence of steelhead trout in most streams in the Northern Subbasin. A BLM survey of the Lower North Fork Mattole River in September 1977 found "many" juvenile steelhead trout. Coastal Headwaters Association surveys in 1981 and 1982 found steelhead trout in Jim Goff Gulch, the Lower North Fork Mattole River, East Mill Creek, Conklin Creek, McGinnis Creek, and the Upper North Fork Mattole River. DFG surveys found steelhead trout in McGinnis Creek and Pritchett Creek in the 1980s and Conklin Creek, Oil Creek, and Rattlesnake Creek in the 1990s. Additionally, DFG electrofishing data from 1992-1995 in Oil Creek, Green Ridge Creek, and Rattlesnake Creek indicated stable multi-year class populations of juvenile steelhead trout.

Unfortunately, although unidentified salmonids were found in the East Branch of the Lower North Fork Mattole River in July 1982 that could have been coho salmon, coho have were not detected in the Northern Subbasin by the 2001 DFG Coho Inventory, 1990s DFG stream surveys, other DFG electrofishing efforts, or a 1997-99Redwood Sciences Laboratory study of juvenile coho salmon distributions in relation to water temperatures in the Mattole Basin (Welsh et al. 2001). More detailed summaries of stream surveys and fisheries studies in the Northern Subbasin are provided in the DFG Appendix.

Fish Passage Barriers

Two stream crossings were surveyed in the Northern Subbasin as a part of the Humboldt County culvert inventory and fish passage evaluation conducted by Ross Taylor and Associates (2000). Conklin Creek Road and Chambers Road both have culverts on East Mill Creek. The culvert on Conklin Creek Road was found to be a temporary salmonid barrier while the culvert on Chambers Road was not found to be a salmonid barrier (Table 20.). Priority ranking of 67 culverts in Humboldt County for treatment to provide unimpeded salmonid passage to spawning and rearing habitat placed the culvert on Conklin Creek Road at rank 17 and the culvert on Chambers Road at rank 36. Criteria for priority ranking included salmonid species diversity, extent of barrier present, culvert risk of failure, current culvert condition, salmonid habitat quantity, salmonid habitat quality, and a total salmonid habitat score. The culvert on Conklin Creek Road is scheduled for improvements in 2002 (G. Flosi, personal communication).

Table 20: Culverts Surveyed for Barrier Status in the Northern Subbasin.

Stream Name	*Road Name*	*Priority Rank*	*Barrier Status*	*Upstream Habitat*	*Treatment*
East Mill Creek (1)	Conklin Creek Road	17	Temporary barrier. A steep gradient and excessive under sizing creates a temporary velocity barrier for adults (which is probably a total barrier to juveniles). Additionally, railroad rails probably contribute to passage problems – the rails break up the slope in steps, yet there is no depth for fish to leap out of when ascending. Woody debris pinned across the culvert also increases velocity and turbulence at inlet.	Approximately 2.7 miles of fair salmonid habitat.	Funded and scheduled for improvement in 2002
East Mill Creek (2)	Chambers Road	36	Not a barrier. The culvert is set below grade with natural channel bottom. Even at low flow there is a backwatering of the downstream end of the culvert.	Approximately 2.0 miles of fair salmonid habitat.	None proposed at this time

Habitat Summary

The Northern Subbasin EMDS evaluations were determined by calculating a mean, area weighted watershed condition value from the Oil Creek, Rattlesnake Creek, Cow Pasture Opening, Petrolia, Apple Tree, Joel Flat, Long Ridge, Rainbow, Camp Mattole, and McGinnis Creek Calwater 2.2 Units. The evaluation results of each subbasin are presented in the EMDS section of the Mattole River

Watershed Profile. The overall condition of the Calwater 2.2 Units were determined by the results of the following level one network factors:

- Passage Barriers (currently with no data in this subbasin)
- Upland Condition
- Road Condition
- Stream Condition

Evaluating the suitability of each of these four watershed condition factors that affect salmon and steelhead provides the degree of subbasin suitability for the fish. The condition of each of these factors, in turn, is determined by evaluating the suitability of the many watershed condition variables that affects it. In all, there are four nested tier levels in the EMDS suitability analysis system. The EMDS system is not predictive, but rather functions as a dynamic filing system to isolate and evaluate the many detailed variables operating in a watershed. These variables are combined in the system much like they interact in the watershed itself.

Each individual variable at level four, the deepest tier, is assigned an evaluation rating between –1 (fully unsuitable) and +1 (fully suitable) compared to known standards that produce conditions that are either good or bad for salmonids. These condition values are passed up through the network according to their power to develop, restrict, or over-ride conditions affecting fish population health. For example, water is the most restrictive variable for fish. Regardless of suitable conditions for other factors like shade canopy, clean gravel, large woody debris, and pool depth, a lack of water over-rides those good conditions and makes the overall result unsuitable for fish. The arrangement of the factors in the system and the way they are combined allows this sort of variable interaction. This functional model provides analysts the capacity for orderly assessment of the watershed's condition. (Figure 5, page 43). Network details are described in Appendix **A** and maps showing EMDS results are provided in Appendix **B**.

The system can be structured to operate with watersheds of various scales from basin level to stream reaches. NCWAP operated the system at the basin, subbasin, Calwater planning watershed, and stream reach scales. Regardless of scale or the ultimate suitability rating an assessment produces, the system allows for backtracking to find the factors that have affected the suitability rating. As such, the system is useful for the identification of watershed improvement opportunities. It is also good at identifying areas of refugia and resources that need protective measures during land use activities.

The system evaluates conditions at a particular moment in time and is static in its analysis. However, it also can be useful for recording changes in watershed factor conditions as discovered through new field assessments or a series of monitoring activities. Changes in suitability of conditions for fish due to both natural processes and restoration efforts can be evaluated in this fashion. Multiple system "runs" over time can therefore document change and be useful for trend analysis. Thus, the ultimate "suitability" ratings are somewhat secondary in importance to the utility of the system for detailed watershed factor condition assessment, diagnostics, and development of recommendations for watershed improvement activities.

The overall watershed condition rating from the EMDS model was moderately unsuitable for the Northern Subbasin. Watershed conditions in the 10 Calwater Units ranged from somewhat unsuitable in the Long Ridge and Rainbow Calwater Units to fully unsuitable in the Oil Creek, Cow Pasture Opening, Petrolia, Joel Flat, Camp Mattole, and McGinnis Creek Calwater Units (Table 21).

Data on fish passage barriers has not yet been incorporated into EMDS. However, this data is presented in the Fish Passage Barriers section of the Northern Subbasin Overview. A culvert on Conklin Creek Road was found to be a temporary salmonid barrier while a culvert on Chambers Road was not found to be a salmonid barrier. Both of these culverts are on East Mill Creek in the Cow Pasture Opening Calwater Unit.

Upland condition in the Northern Subbasin was rated somewhat unsuitable by EMDS. All Calwater Units in the Subbasin had either somewhat or moderately unsuitable upland conditions except for the Petrolia Calwater Unit where the upland condition was undetermined. Fully suitable ratings for early seral were balanced by moderately and fully unsuitable ratings for upland cover and canopy in all Calwater Units. Similarly, slope stability and land use were somewhat to fully unsuitable in all Calwater Units except for the Petrolia Calwater Unit.

Road condition in the Northern Subbasin was rated somewhat unsuitable by EMDS. Road condition ratings ranged from moderately suitable in the Rainbow Calwater Unit to moderately unsuitable in the Cow Pasture Opening and Joel Flat Calwater Units. Road use was undetermined in all Calwater Units while ratings for stream crossings, road density by hillslope position, road density unstable, and road proximity ranged widely: from fully unsuitable to fully suitable for stream crossings, road density unstable, and road proximity; and from moderately suitable to fully unsuitable for road density by hillslope position.

In the Mattole Basin, the Ecological Management Decision Support system (EMDS) evaluated four main condition factors:

Passage Barriers,

Upland Condition,

Road Condition,

and **Stream Condition**. Of these, Upland, Road, and Stream Condition values are products of several condition factors, which are also listed in Table X. Finally, all four main factors are combined to produce an **Overall Watershed Condition** value. Please refer to a detailed explanation of EMDS on page 37.

Key:

+++	Fully suitable
++	Moderately suitable
+	Somewhat suitable
U	Undetermined
-	Somewhat unsuitable
--	Moderately unsuitable
---	Fully unsuitable

Table 21: EMDS Watershed Suitability Ratings for the Northern Subbasin by CalWater 2.2 Unit.

Condition Factor \ Watershed Unit	North Subbasin	Oil Creek	Rattlesnake Creek	Cow Pasture Opening	Petrolia	Apple Tree	Joel Flat	Long Ridge	Rainbow	Camp Mattole	McGinnis Creek
Passage Barriers	U	U	U	U	U	U	U	U	U	U	U
Upland Cover	- -	- - -	- -	- - -	- - -	- - -	- - -	- -	- -	- - -	- - -
Canopy	- -	- - -	- -	- - -	- - -	- - -	- - -	- -	- -	- - -	- - -
Early Seral	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
Slope Stability	+	- -	- -	-	+++	- -	-	- -	- -	-	- -
Land Use	-	- -	-	- -	++	- -	-	-	-	- - -	- - -
Upland Condition	-	- -	- -	-	U	- -	-	-	-	-	- -
Road Use	U	U	U	U	U	U	U	U	U	U	U
Stream Crossings	-	-	-	- - -	- - -	- - -	- - -	-	+++	++	+
Road Density By Hillslope Position	-	-	-	- - -	- -	-	- -	- -	++	-	- -
Road Density Unstable	-	+	- -	+	+++	++	- - -	- -	+	+	- - -
Road Proximity	+	+	+	- - -	- -	- - -	- - -	++	+++	+	++
Road Condition	-	+	-	- -	-	-	- -	-	++	+	-
Water Temperature	U	U	U	U	U	U	U	U	U	U	U
Stream Flow	U	U	U	U	U	U	U	U	U	U	U
Riparian	- -	- - -	++	- - -	- - -	- -	- - -	- -	+	- - -	- - -
Reach Condition	-	-	--	-	U	U	U	U	-	U	U
Stream Condition	-	- - -	- -	- - -	- - -	- -	- - -	- -	-	- - -	- - -
Overall Watershed Condition	- -	- - -	- -	- - -	- - -	- -	- - -	-	-	- - -	- - -

Stream condition in the Northern Subbasin was rated somewhat unsuitable by EMDS. Data on water temperature and stream flow have not yet been incorporated into EMDS. However, water temperature data is presented in the North Coast Water Quality Control Board Appendix and stream flow data is presented in the Department of Water Resources Appendix and in individual stream survey report summaries (Appendix X). Streams temperatures were collected in the Lower North Fork of the Mattole River which flows through the Petrolia, Joel Flat, Apple Tree, and Long Ridge Calwater Units; Conklin Creek which is in the Cow Pasture Opening Calwater Unit; and the Upper North Fork of the Mattole River which forms the border between the Oil Creek and Rattlesnake Creek Calwater Units. Average high temperatures in Green Ridge Creek in 1991 and Oil Creek during 1991, 1993, and 1994 exceeded the critical peak lethal temperature threshold of 75 ^{o}F established for salmonid survival. Green Ridge Creek and Oil Creek are in the Oil Creek Calwater Unit. The Lower North Forth Mattole River, Conklin Creek and the Upper North Fork Mattole River are not supportive of the COLD beneficial use of water for salmonid habitat. Riparian ratings ranged from moderately suitable in the Rattlesnake Creek Calwater Unit to fully unsuitable in the Oil Creek, Cow Pasture Opening, Petrolia, Joel Flat, Camp Mattole, and McGinnis Creek Calwater Units. Reach condition was somewhat unsuitable in the Oil Creek, Cow Pasture Opening, and Rainbow Creek Calwater Units, moderately unsuitable in the Rattlesnake Creek Calwater Unit, and undetermined for the other Calwater Units.

Reach condition was assessed by EMDS using stream attributes such as canopy cover, embeddedness, percent pools, pool depth, and pool shelter. These attributes were collected in seven streams in the Northern Subbasin by DFG (see Appendix X for stream survey report summaries). Oil Creek, Devil's Creek, and Green Ridge Creek are in the Oil Creek Calwater Unit. Rattlesnake Creek is in the Rattlesnake Creek Calwater Unit, Conklin Creek is in the Cow Pasture Opening Calwater Unit, and Sulphur Creek and Tributary #2 to Sulphur Creek are in the Rainbow Calwater Unit.

Stream attributes tend to vary with stream size. For example, larger streams generally have more open canopy and deeper pools than small streams. This is partially a function of wider stream channels and greater stream energy due to higher discharge during storms. Surveyed streams in the Northern Subbasin ranged in drainage area from 1.15 to 9.4 square miles (Figure 23).

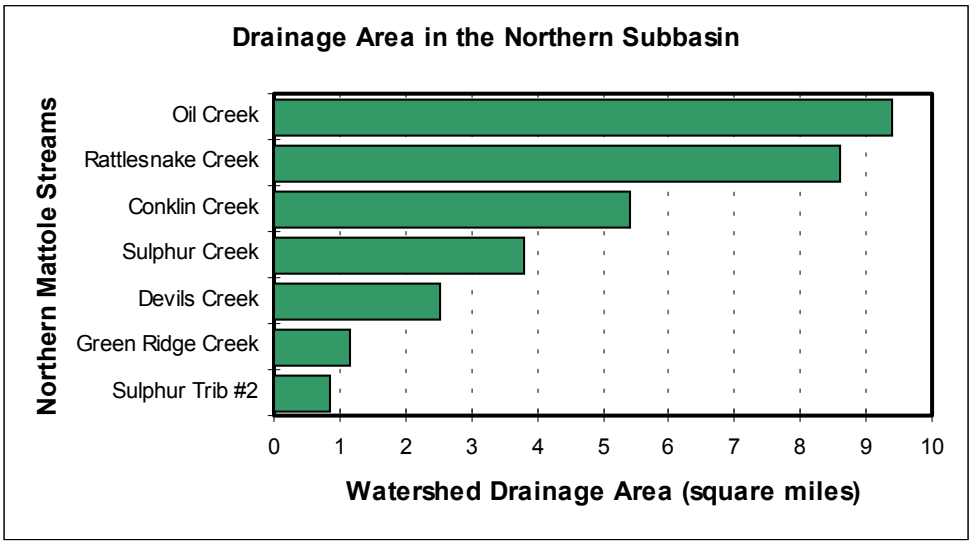


Figure 23: Drainage Area of Stream Surveyed by DFG in the Northern Subbasin.

Canopy cover, and relative canopy cover by coniferous versus deciduous trees were measured at each habitat unit during DFG stream surveys. Near-stream forest density and composition contribute to microclimate conditions that help regulate air temperature, which is an important factor in determining stream water temperature. Furthermore, canopy levels provide an indication of the potential present and future recruitment of large woody debris to the stream channel, as well as the insulating capacity of the stream and riparian areas during winter.

In general, the percentage of stream canopy cover increases as drainage area, and therefore channel width, decrease. Deviations from this trend in canopy may indicate streams with more suitable or unsuitable canopy relative to other streams of that subbasin. As described in the EMDS response curves, total canopy (sum of conifer and deciduous canopy) exceeding 85% is considered fully suitable, and total canopy less than 50% is fully unsuitable for contributing to cool water temperatures that support salmonids. The surveyed stream reaches of the Northern Subbasin show percent canopy levels that are rated by the EMDS as somewhat unsuitable or worse for maintaining water temperature to support anadromous salmonid production (Figure 24). Sulphur Creek and its tributary have the highest canopy cover values of Northern Subbasin, and the highest percent conifer canopy among all Mattole streams surveyed.

Cobble embeddedness was measured at each pool tail crest during DFG stream surveys. Cobble embeddedness is the percentage of an average sized cobble piece at a pool tail out that is embedded in fine substrate. Category 1 is 0-25% embedded, Category 2 is 26-50% embedded, 51-75% Category 3 is embedded, Category 4 is 76-100% embedded, and Category 5 is unsuitable for spawning due to factors other than embeddedness. Cobble embedded deeper that 51% is not within the fully supported range for successful use by salmonids. The EMDS Reach Model considers cobble embeddedness greater than 50% to be somewhat unsuitable and 100% to be fully unsuitable for the survival of salmonid eggs and embryos. Embeddedness values in the Northern Subbasin represent conditions that are moderately unsuitable or unsuitable for successful salmonid egg and embryo development with the exception of Sulphur Creek (somewhat suitable) and its tributary (somewhat unsuitable). However, Figure 25 illustrates how stream reaches rated as unsuitable overall may actually have some suitable spawning gravel sites distributed through the stream reach.

Pool, flatwater, and riffle habitat units observed were measured, described, and recorded during DFG stream surveys. During their life history, salmonids require access to all of these types of habitat. EMDS does not evaluate the ratio of these habitat types, but a balanced proportion is desirable. Most of the surveyed Northern Subbasin streams have less than 20% pool habitat by length (Figure 26). This is well below the range considered fully suitable as described below. Dry units were also measured, and obviously indicate poor conditions for fish.

Pool depths were measured during DFG surveys. The amount of primary pool habitat of sufficient depth to be fully suitable for anadromous salmonids is considered in the EMDS Reach Model. Primary pools are determined by a range of pool depths, depending on the order (size) of the stream. Generally, a reach must have 30 – 55% of its length in primary pools for its stream class to be in the suitable ranges (EMDS Table 4). Generally, larger streams have deeper pools. Deviations from the expected trend in pool depth may indicate streams with more suitable or unsuitable pool depth conditions relative to other streams of that subbasin. Rattlesnake Creek has the most pool habitat with maximum depth greater than 3 feet, but this measures only 6% of total pool length (Figure 27). The EMDS rates pool quality in all Northern Subbasin streams as moderately unsuitable or unsuitable for supporting anadromous fish populations.

Pool shelter was measured during DFG surveys. Pool shelter rating illustrates relative pool complexity, another component of pool quality. Ratings range from 0-300. The Stream Reach EMDS model evaluates pool shelter to be fully unsuitable if less than a rating of 30. The range from 100 to 300 is fully suitable. Pool shelter ratings in the Northern Subbasin, according to the EMDS stream reach model, range from somewhat unsuitable to unsuitable (Figure 28).

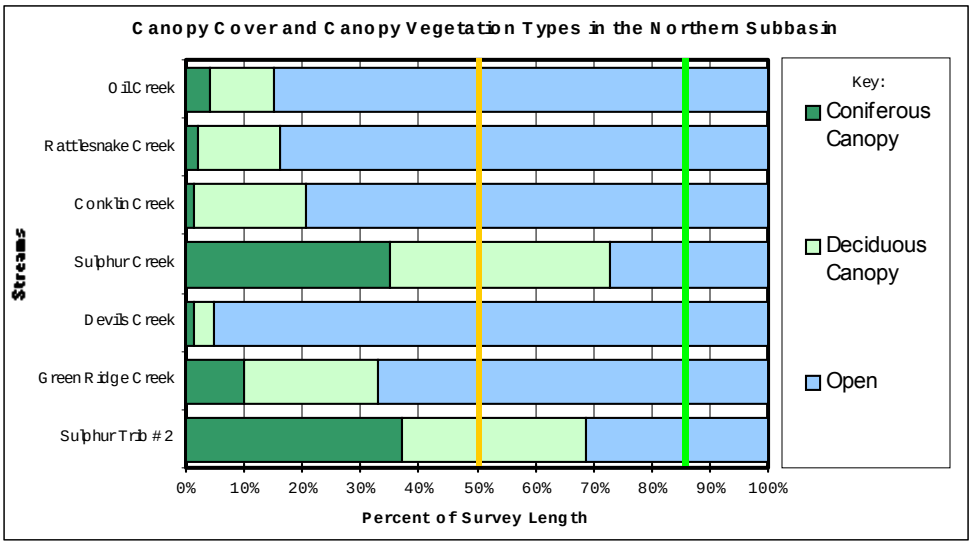


Figure 24: The Relative Percentage of Coniferous, Deciduous, and Open Canopy Covering Surveyed Streams, Northern Subbasin.

Averages are weighted by unit length to give the most accurate representation of the percent of a stream under each type of canopy. Streams are listed in descending order by drainage area (largest at the top). As described in the EMDS response curves, total canopy (sum of conifer and deciduous canopy) exceeding 85% (green line) is considered fully suitable, and total canopy less than 50% (yellow line) is fully unsuitable for contributing to cool water temperatures that support salmonids.

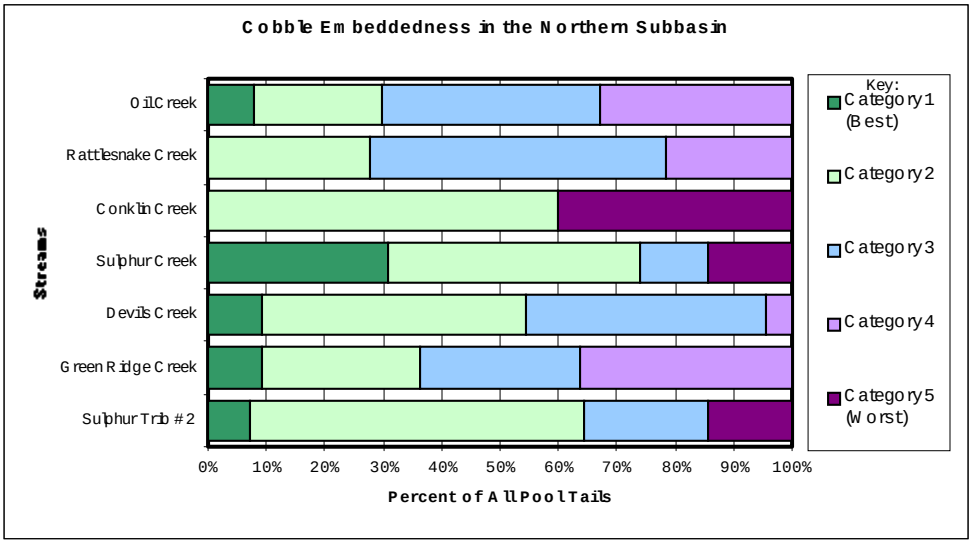


Figure 25: Cobble Embeddedness Categories as Measured at Every Pool Tail Crest in Surveyed Streams, Northern Subbasin.

Cobble embeddedness is the % of an average sized cobble piece at a pool tail out that is embedded in fine substrate: Category 1 = 0-25% embedded, Category 2 = 26-50% embedded, Category 3 = 51-75% embedded, Category 4 = 76-100%, and Category 5 = unsuitable for spawning due to factors other than embeddedness (e.g. log, rocks). Substrate embeddedness Categories 3, 4, and 5 are considered by EMDS to be somewhat unsuitable to fully unsuitable for the survival of salmonid eggs and embryos. Streams are listed in descending order by drainage area (largest at the top).

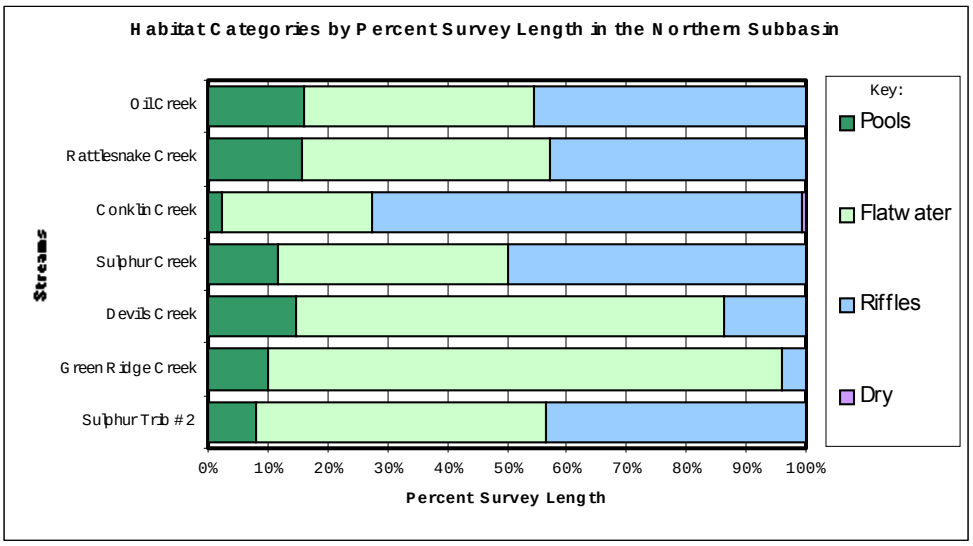


Figure 26: The Percentage of Pool Habitat, Flatwater Habitat, Riffle Habitat, and Dewatered Channel by Surveyed Length, Northern Subbasin.

EMDS does not evaluate the ratio of these habitat types, but a balanced proportion is desirable. Streams are listed in descending order by drainage area (largest at the top).

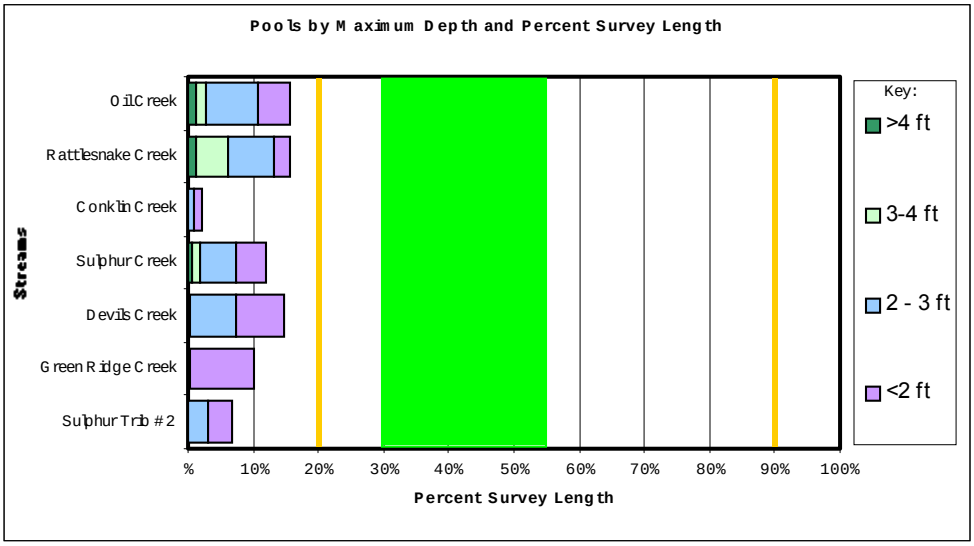


Figure 27: Percent Length of a Survey Composed of Deeper, High Quality Pools, Northern Subbasin.

Values sum to the length of percent pool habitat in Figure 26. As described in the EMDS response curves, a stream must have 30-55% (green area) of its length in primary pools to provide stream conditions that are fully suitable for salmonids. Streams with <20 % or >90% (yellow lines) of their length in primary pools provide conditions that are fully unsuitable for salmonids. Streams are listed in descending order by drainage area (largest at the top).

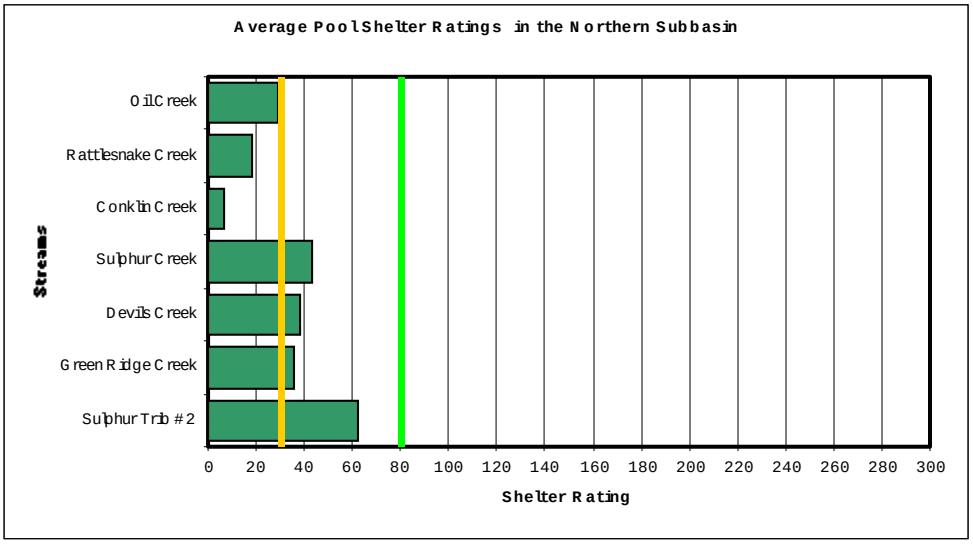


Figure 28: Average Pool Shelter Ratings from DFG Stream Surveys.

As described in the EMDS response curves, average pool shelter ratings exceeding 80 (green line) are considered fully suitable and average pool shelter ratings less than 30% (yellow line) are fully unsuitable for contributing to shelter that supports salmonids. Streams are listed in descending order by drainage area (largest at the top).

Subbasin Trends

The trends for several factors within the Mattole River tributaries in the Northern subbasin can be summarized as follows. The size and density of the riparian zone woody vegetation in timberlands will increase over time due to timber harvesting plan regulations. Lands owned by the Pacific Lumber Company have additional restrictions that are part of their Habitat Conservation Plan. There is no trend in vegetation change that can be inferred for riparian areas that are bordered by grasslands. Humboldt County requires new construction set-backs from watercourses that will help preserve existing riparian vegetation, but the clearing of vegetation by landowners as part of rural residential living is not regulated outside of the Coastal Zone. Trends for riparian zones bordered by or containing roads are also unclear. It is possible that some roads may be abandoned and riparian vegetation re-established, but many of the roads are County roads, lead to streamside County roads, or access home sites. Riparian vegetation may be sacrificed in road maintenance activities, both regular and storm induced.

The number of roads within the watershed can be expected to increase as timberlands are harvested for the first time since the application of current Forest Practice rules. These rules and current practices generally require road systems located high on the slope unlike earlier timber harvest and transportation systems that established roads low on the slopes, often near streams.

The short time period of stream temperature data results does not allow for any trend analysis. There is no data on suspended sediment.

The fluvial geomorphology is characterized by the relatively highest percentage of disturbed channel and stream bank erosion of the Mattole subbasins. While most of the Northern subbasin remained in a nearly static condition from 1984-2000, certain areas of the Joel Flat planning watershed appears to have shown a significant decrease in disturbed channel. Analysis of previous years has not been undertaken to see if this is a continuing trend. Both the 1955 and 1964 floods were one hundred year

return events while all other major storm events in the years 1951-2000, the period of record for the Petrolia stream gauge, hover around the ten-year flood event level.

Current estimated populations of chinook salmon and coho salmon throughout the Mattole Basin are low compared to United States Fish and Wildlife Service (USFWS) estimated populations in 1960. Outmigrant trapping of steelhead trout appears to indicate that their population is closer to the 1960 USFWS population estimate. However, not enough quantitative data on any salmonid species exists to establish clear trends on a subbasin basis.

Northern Subbasin Issues

- There is concern over abandoned roads, new road construction, and road maintenance issues related to land-sliding and sediment input. Without appropriate maintenance or storm proofing, existing roads, both active and abandoned, may continue to contribute high rates of sediment.

- Currently, there is no road assessment program in this planning basin.

- If future sub-division development is proposed, the county-imposed 40-acre minimum parcel sub-division ordinance with the preponderance of unstable slopes and sediment issues will need to be addressed.

- The bedrock underlying the northern subbasin is dominated by mélange which is highly susceptible to landslides and erosion. The subbasin contains some of the largest continuous areas of large landslides, historically active earthflows, and high to very high landslide potential; of the all the subbasins (CGS, 2002).

- The delivery of sediment to streams is prevalent through gully erosion and debris slides associated with large active and dormant landslides as well as from debris flows and debris slides which form on the harder terrain at higher elevations (CGS, 2002).

- In the Lower North Fork, the high rate of sediment input from erosion and mass wasting is reflected in the accumulation of debris and alluvial fans at the mouths of many tributary drainages (CGS, 2002).

- Eroding banks are found in localized areas throughout the Northern subbasin and are commonly associated with areas of inner gorges and active landslides. The Rattlesnake Creek, Long Ridge, McvGinnis Creek and Oil Creek PWs have some of the longest total lengths of eroding bank within the subbasin. (CGS, 2002)

- The Northern subbasin is the only subbasin within the Mattole Watershed that shows a significant increase in the number of gullies from 1984 to 2000. (CGS, 2002)

- The Cow Pasture Opening Planning Watershed (PW) is the only PW in the Northern subbasin that has demonstrated an increase in both the number of gullies and negative channel characteristics from 1984 to 2000. (CGS, 2002)

- Water temperature data suggests that summer high temperatures exceed fully suitable conditions for salmonids throughout much of this planning basin.

- Based upon limited samples from Oil and Rattlesnake creeks there is an indication that fine sediments may be approaching or exceeding levels that are considered suitable for diverse and complex salmonid habitat.

- Canopy density (cover) is below EMDS target values. Excess instream sediment appears to be causing channel widening, leading to less stream canopy density.

- Based on limited sampling taken from 1991 to 1999, mainly in the Upper North Fork drainage, coho have not been found. Four years of electrofishing in three streams (Oil, Green Ridge, and Rattlesnake creeks) show stable multi-year class populations of juvenile steelhead.

- Large woody debris recruitment potential is very poor overall due to prevalence of grasslands and lack of streamside vegetation. Land use practices may be exacerbating the naturally occurring adverse conditions.

- Fish population information is poor due to access issues for surveys. In order to protect privacy while developing data, the possibility of training local landowners to survey their own streams to conduct salmonid population status surveys would be advisable to help determine fish populations throughout this planning basin.

Northern Subbasin Issue Synthesis

Working Hypothesis 1:

SUMMER STREAM TEMPERATURES IN MANY SUBBASIN TRIBUTARIES ARE NOT WITHIN THE RANGE OF TEMPERATURES THAT ARE FULLY SUITABLE FOR HEALTHY ANADROMOUS SALMONID POPULATIONS.

Supportive Findings:

- Summer stream temperatures were measured to exceed levels fully suitable for salmonids at most locations sampled.

- Shade canopy levels appear to be low as a function of both riparian cover depletion from land use and stream widening due to high sediment inputs resulting from floods in 1955 and 1964.

- Air photo analysis indicates that in timberland areas, timber harvest activities prior to 1973 also reduced canopy closure near streams.

- Air and historic photo documentation, after the 1955 and 1964 floods, indicate significant changes in many channels in the Northern subbasin.

Working Hypothesis 2:

AGGRADATION FROM FINE SEDIMENT IN SOME STREAM CHANNELS OF THIS SUBBASIN HAS REDUCED CHANNEL DIVERSITY NEEDED TO PROVIDE SUITABLE CONDITIONS FOR ANADROMOUS SALMONID POPULATIONS AND HAS COMPROMISED SALMONID HEALTH.

Supportive Findings:

- Field surveys indicate that sediment delivery has had an adverse and long lasting impact to salmonid habitat in the Northern subbasin.

- Air [DFG12]photo analysis and field observation indicate that the lower reaches of the large tributaries to the Mattole River are highly aggraded with fine sediment.

- Late [DFG13]summer field observations indicate that aggradation and channel widening have likely contributed to a loss of surface stream flow.

- Several areas of on-going high sediment deposition were observed along the Lower North Fork near Petrolia and Upper North Fork near Honeydew. These areas of deposition have been attributed to backwater effects with the mainstem Mattole River. Backwater effects occur where the stage versus discharge relationship is controlled by the geometry downstream of the area of interest (e.g., a high riffle controls conditions in the upstream pool at low flow). However, in the case of the Lower North Fork at Petrolia and the Upper North Fork at Honeydew, we conclude from our observations that the backwater effects mapped at these locations are controlled by a hydrologic point of constraint caused by the mainstem Mattole at high flows (CGS, 2002).

Contrary Finding:

- Review of photographs from the early 1900s combined with anecdotal statements indicate that the Lower North Fork of the Mattole River near Petrolia has been an area of episodic sediment accumulation since the early 1900's. (CGS, 2002).

Working Hypothesis 3:

A LACK OF LARGE WOODY DEBRIS IN SOME STREAM REACHES OF THIS SUBBASIN HAS REDUCED CHANNEL DIVERSITY NEEDED TO PROVIDE SUITABLE CONDITIONS FOR ANADROMOUS SALMONID POPULATIONS AND HAS COMPROMISED SALMONID HEALTH.

Supportive Findings:

- Field observations indicate that the amount of instream large woody debris in the mainstem Mattole River and its tributaries in the Northern subbasin is inadequate.

- Riparian vegetation is in small diameter size classes that are not expected to contribute large woody debris in significant quantities in the near future.

Recommendations:

1. Monitor summer water and air temperatures to detect trends using continuous, 24 hour monitoring thermographs.

2. Where current canopy is inadequate and site conditions are appropriate, initiate tree planting and other vegetation management to hasten the development of denser and more extensive riparian canopy.

3. Encourage the use of cable or helicopter yarding on steep and unstable slopes to reduce soil compaction, surface disturbance, and resultant sediment yield.

4. Encourage the monitoring of in-channel sediment and tracking of aggraded reaches in the lower basin by establishing monitoring stations and training personnel.

5. Maintain and enhance existing riparian cover. Use cost share programs and conservation easements as appropriate.

6. Based upon the latest science on placement of large woody debris instream channels, managers in the Northern subbasin should work to improve channel structure and function, and habitat complexity and diversity for salmonids.

7. Continue efforts such as road erosion proofing, improvements, and decommissioning throughout the basin to reduce sediment delivery to the Mattole River and its tributaries.

8. At stream bank erosion sites, encourage cooperative efforts to reduce sediment yield to streams.